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Description of the female of *Platycheirus altomontis* Merlin & Nielsen in Nielsen, 2004 (Diptera, Syrphidae) with notes on the occurrence and hilltopping behaviour of rare French montane and Alpine Syrphidae

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Abstract

A focused search in very high (2500–3200 m asl) Alpine mountain tops in France resulted in the discovery of the very rare Alpine-endemic syrphid *Platycheirus altomontis* Merlin & Nielsen *in* Nielsen, 2004, including its hitherto unknown female. A description of the female is given and further complemented with behavioural observations of this species with special reference to hilltopping. Additional records and behavioural observations are provided for rare and new species for the French fauna from the montane and Alpine habitat with focus on species of high altitude (>2750 m) and hilltopping behaviour. The species *Rohdendorfia alpina* Sack 1938 is new to France and was observed in large numbers at scree slopes above 2750 m and males were found sitting at hilltops up to 3200 m. Hilltopping behaviour of Syrphidae was observed over the whole altitudinal range visited, and multiple species engaged in this behaviour even at above 3000 m. Hilltopping appears to be more common in some genera (e.g. *Parasyrphus* and *Pipizella*) than in others and may be linked to specific phenotypes in some species. The latter was observed for the species *Cheilosia melanura* (Becker, 1894) of which at high hilltops much smaller males were found than at lower altitudes.

Key Words

hilltopping, *Rohdendorfia*, France, Alps, mate finding strategy

Introduction

France has the largest expanse of territory of any state currently within the European Union, and also has the longest list of Syrphidae, with 555 species (Speight et al. 2018) and several new species added since. Within such a vast expanse (549.000 km²) it is not surprising that large differences exist in the sampling effort among different areas, and many areas remain undersampled. Especially from the less investigated areas, new species for France are still reported regularly (Lair 2018a, 2018b). Undersampling not only refers to the number of samples in an area but also to sampling over its entire altitudinal gradient and over the season. The French Alps have been thoroughly investigated over many years for Syrphidae (Verlinden 2020) but less so during summer and probably never before at high altitudes. With the high mountain habitat and its communities increasingly under threat (Beniston 2005), increasing our knowledge on the contemporary high mountain fauna not only would improve our general knowledge on the national fauna of France, but also may provide a unique time document and provide a baseline to help to understand how these communities may be affected by ongoing threats in the future.

Hilltopping is a mate-finding strategy encountered in many insect families (Skevington 2008). This interesting behaviour is very common in Syrphidae but has received little attention so far in literature (Waldbauer 1990; Schmid 1999; Alcock 2011). In the Alpine environment with many pronounced hilltops, hilltopping is probably a common phenomenon, and it can be expected that some

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rare species may be more easily found this way, as they concentrate around hilltops (Skevington 2008). Apart from knowing which species engage in this behaviour, an interesting question is whether in summer hilltopping by Syrphidae also occurs at very high hilltops (>3000 m asl) far above the tree line and whether specific species of the high mountain habitat are involved.

The main objectives of this study are to answer the above questions: provide an overview of the hover fly community of the Alpine habitat with special focus on very high mountains (>2800 m), and determine which species use hilltopping behaviour and to what height this behaviour occurs. Several expeditions to high mountain areas in France (mainly the Alps and the Pyrenees) were conducted with special focus on high mountain hover fly communities and on their hilltopping behaviour. The presence and behaviour of rare species will be discussed and an overview generated of the species that showed hilltopping behaviour. Lastly, a description of the hitherto undescribed female of *Platycheirus altomontis* Merlin & Nielsen in Nielsen, 2004 is provided.

Materials and methods

Between 2019 and 2021, several excursions were undertaken by the author to the French Alps, the French Pyrenees and the Ardèche. An overview of the reported excursions, their duration and the altitudinal range covered can be found in Table 1. Both the excursions to the Alps were focused on hilltops and high landmarks in the landscape, but especially in July the highest accessible points in the area were targeted. On all days the weather was favourable with long sunny spells and wind speed never exceeding 4 Bf. Hilltops were searched on eye sight and token specimens collected with a hand net. All collected syrphids are preserved in the personal collection of the author (Tessenderlo, Belgium). Identification of the hoverflies was achieved by a combination of different sources: Barkalov and Ståhls (1997), Nielsen (2004, 2014), van Veen (2004), Šašić et al. (2016), Ståhls and Barkalov (2017) and Speight and Sarthou (2015). Names of Syrphidae follow those in the Syrph the Net volumes (Speight, 2020).

Table 1. Overview of the visited mountain regions in France with indication of the visited localities, the dates, and the investigated altitudinal range.

Region: localities	Period	Year	Altitudinal range (m asl)
French Alps: Vars, Villar-d`Arêne, Freissinières	19–26 June	2020	770–2430 (mainly 1700–2300)
French Alps: Vars, Villar-d`Arêne, Molines-en-Queyras	25–28 July	2020	1160–3140 (mainly >2500)
French Pyrenees: Bagnères-de-Bigorre, Bordes-Uchentein.	14–19 July	2020	930–1950 (mainly 930–1350)
Ardèche: Lafarre, St.-Jeure-d'Andaure	4–9 August	2021	550–1250

Hoverflies were studied under a WILD M5a stereomicroscope (magnification 6-50x). The terminology used to describe the female of *P. altomontis* followed Cumming and Wood (2017). Body length was measured from the top of the antenna to the tip of the abdomen. Photographs were taken to illustrate some rare species and to support the description of the female of *P. altomontis*. All photographs except of *Rohdendorfia alpina* Sack 1938 were taken by Sander Bot with a Canon EOS 6D camera Body and a Mejiro Genossen FL0530 4.0/110 Float Lens (habitus photos) or Leitz-Wetzlar Photar 1:2/25 macro lens (remainder of photos). Before stacking in Helicon Focus 7.7.5 (Kharkiv, Ukraine), exposure and sharpening of the photos was adjusted in Adobe Lightroom Classic (version 10.4).

No strict criteria exist for recognizing an insect present at a hilltop as a hilltopper. Skevington (2008) explains that true hilltopping is a mate finding strategy whereby males await (often virgin) females, which implies that the population of a hilltopping species should be strongly male-biased. Also males should execute some sort of mate finding behaviour, but this behaviour can be very different among species and is therefore difficult to define. For this study, a species was considered as doing hilltopping when the species was present at or near a hilltop, when a clear male bias was seen and/or when males displayed some behaviour that could be recognized as mate finding behaviour (hovering, patrolling or sitting on stones, trees or other landmarks, chasing other insects). Searching for hilltopping insects anticipated on the known partitioning of the hilltop by different species (Skevington, 2008). We therefore investigated different niches at the hilltop (bare stones, small trees, tree trunks, sheltered versus exposed side of the hilltop, etc…), at different distances from the summit.

Results

Platycheirus altomontis Merlin & Nielsen in Nielsen, 2004

Examined material. FRANCE • 1 female, 05-Hautes-Alpes, Molines-en-Queyras, near Pain de Sucre, 44.698°N, 6.991°E, 2780 m, 26 Jul. 2020; 3 males, 2 females, 05-Hautes-Alpes, Vars, La Mortrice, 44.574°N, 6.769°E, 3142 m, 27 Jul. 2020.

Two high mountain tops were searched and both produced *P. altomontis*. A female was found feeding on small white flowers near the top of the Pain de Sucre, and 3 males and 2 females were found on the top of La Mortrice. The females were visiting small flowers, the males were feeding or sitting on the stones, from which they made short flights, suggestive of hilltopping behaviour. The female of *P. altomontis* is unknown so far and is described below. Females of *P. altomontis* were identified as such because they occurred together with the males, and because they shared some typical characters also found in the males including the very dark legs, the very broad

head, and the very long hairs on the head and thorax. A male *P. altomontis* is shown in Fig. 1, the female is shown in Figs 2–4.

Description of the female of *P. altomontis*. The following description is based on the three collected females.

Head (Figs 2, 3): Eyes bare, frons at the height of the antenna distinctly broader than an eye. Third antennal segment (flagellum) 1.2 to 1.6 times longer than wide, dark grey-brown but narrowly orange below at base, scape and pedicel black, arista relatively short and thick, slightly longer than flagellum. Face below the antennae with very long, white pilosity, mainly at the sides, as long or longer as the distance between the posterior ocelli. Face completely covered with thin grey pollinosity, frons and vertex undusted except narrow triangular paired dust spots that each reach one third of the width of the frons. Frons with long white to dark grey pilosity, about as long as the 3rd antennal segment. Facial tubercle and mouth edge distinctly protruding, occiput completely pollinose but denser pollinose on ventral side.

Thorax (Fig. 3): Scutum and scutellum shining metallic blue-black with long white pilosity, as long or longer as flagellum. Pleurae and humerus with thin grey pollinosity and rather long white pilosity.

Wing: Stigma light yellow. Wing covered with microtrichia, except cell bm, br and cua microtrichose apically, otherwise bare. Calypter yellow-white, haltere yellow-brown.

Legs: All legs completely dark with thin grey pollinosity, but tibiae narrowly yellow at base and femora yellow at their distal end. Legs entirely pale-haired. Coxae and trochanters of usual shape.

Abdomen (Fig. 4): Relatively short and broad, tergites 2 and 3 more than 2 times broader than long. Abdomen dark grey-black, largely matt except large shining areas in the frontal corners at the sides of all tergites. Tergites 3 and 4 on these shining areas with large semi-rectangular spots of white-grey pollinosity with rounded inner corners, covering somewhat more than half the length of the median axis of the tergite. Pilosity on abdomen pale; sparse, short and adpressed centrally, long and erect laterally. Pilosity on sternites pale. Pilosity on s1-2 very long and erect, on 3–5 short and adpressed.

Body length: 6–7 mm.

Of the 23 species in the *Platycheirus ambiguus* group, the females are as yet unknown for 8 species. In the key for females of Nielsen (2014) the female of *P. altomontis* would run to *P. lundbecki* (Collin, 1931). No material of *P. lundbecki* females was available to me to compare with, therefore no differential diagnosis relative to that species is provided. Based on current knowledge of the distribution of the species, the area of origin may be decisive for deciding which species is involved (Nordic countries: *P. lundbecki*, high Alpine mountain tops: *P. altomontis*). From all other known species of the *P. ambiguus* group the female of *P. altomontis* differs by the rather small, compact build with short and broad, black abdomen with grey dust spots and very dark legs.

The female resembles the male of *P. altomontis* apart from the usual sexual dimorphism found within this genus.

Figure 1. Habitus dorsal view of a male *Platycheirus altomontis*, 27.Vii.2020, Vars, la Mortrice (photo by Sander Bot).

Figure 2. Frontal view of the head of a female *P. altomontis*, 27.Vii.2020, Vars, la Mortrice (photo by Sander Bot).

Figure 3. Side view of the head and thorax of a female *P. altomontis*, 27.Vii.2020, Vars, la Mortrice (photo by Sander Bot).

Figure 4. Dorsal view of the abdomen of a female *P. altomontis*, 27.Vii.2020, Vars, la Mortrice (photo by Sander Bot).

Additional records and observations of rare and new syrphids from the French mountains

All expeditions combined, a total of 205 species of Syrphidae have been observed in mountains in France by the author (see Suppl. material 1). Of these, two species are new to France and 26 species occur in 5 or less French departments based on Speight et al. (2018) and may be considered rare in the French context. Below an alphabetically ordered account of these rare and new species recorded in France is given. If applicable, details on ecological observations are provided. All records are leg. and coll. F. Van de Meutter and are from France, unless otherwise stated. For each location, the department with its number (if in France), the height above sea level in meters, and decimal coordinates (WGS84) are provided. Observations are annotated with behavioural observations mainly regarding hilltopping.

- ***Cheilosia crassiseta*** **Loew, 1859**

Examined material. FRANCE • 1 male, 05-Hautes-Alpes, Villar-d'Arêne, Col du Lautaret, 45.029°N, 6.401°E, 2075 m, 21 Jun.2020; 2 males, 05-Hautes-Alpes, Molines-en-Queyras, near Pain de Sucre, 44.698°N, 6.991°E, 2780 m, 26 Jul. 2020; 2 males, 5 females, 05-Hautes-Alpes, Vars, near La Mortrice, 44.574°N, 6.760°E, 2844 m, 27 Jul. 2020.

- ***Cheilosia marginata*** **(Becker, 1894)**

Examined material. FRANCE • 2 males, 05-Hautes-Alpes, Villar-d'Arêne, Col du Lautaret, 45.029°N, 6.401°E, 2075 m, 21 Jun. 2020.

- ***Cheilosia pascuorum*** **Becker, 1894**

Examined material. FRANCE • 1 female, 05-Hautes-Alpes, Vars, Val d'Escreins, 1780 m, 44.623°N, 6.716°E, 20 Jun. 2020.

- ***Dasysyrphus postclaviger*** **(Stys & Moucha, 1962)**

Examined material. FRANCE • 2 females, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.623°N, 6.716°E, 1780 m, 20 Jun. 2020; 1 male, 05-Hautes-Alpes, Vars, Val

d'Escreins, 44.613°N, 6.743°E, 2010 m, 24 Jun. 2020; 1 female, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.621°N, 6.721°E, 1792 m, 24 Jun. 2020.

- ***Eristalis alpina* (Panzer, 1798)**

Examined material. FRANCE • 1 male, 07-Ardèche, Lafarre, 45.058°N, 4.496°E, 550 m, 4 Aug. 2021; 1 male, 1 female, ibidem, 6 Aug. 2021.

Notes. Previously only known from one department in the Alps. On observation.org, however, a female *E. alpina* has been reported from Central France by Menno Reemer at Valcivières, indicating more populations or a metapopulation may be present in the mountainous of the south-central part of France.

- ***Melangyna barbifrons* (Fallén, 1817)**

Examined material. FRANCE • 1 female, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.611°N, 6.743°E, 2140 m, 20 Jun. 2020; 1 female, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.605°N, 6.766°E, 2280 m, 22 Jun. 2020.

Both specimens were caught on flowering *Salix* sp..

- ***Melangyna quadrimaculata* (Verrall, 1873)**

Examined material. FRANCE • 1 female, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.605°N, 6.766°E, 2280 m, 22 Jun. 2020.

On flowering *Salix* sp..

- ***Melangyna ericarum* (Collin, 1946)**

Examined material. FRANCE • 1 male, 05-Hautes-Alpes, la Danchère, path to Lac Lauvitel, 1180 m, 44.982°N, 6.072°E, 25 Jul. 2019; 2 males, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.614°N, 6.746°E, 1950 m, 20 Jun. 2020; 1 male, 1 female, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.611°N, 6.743°E, 2140 m, 20 Jun. 2020; 1 female, 05-Hautes-Alpes, Freissinières, 44.712°N, 6.447°E, 2050 m, 23 Jun. 2020; 1 female, 05-Hautes-Alpes, Cervières, Le Laus, 44.849°N, 6.735°E, 1805 m, 25 Jun. 2020.

Notes. This species is poorly described in current literature but can be identified with Speight and Sarthou (2015). Possibly overlooked to some extent. Males were observed hovering above forest tracks in pine wood.

- ***Merodon atratus* (Oldenberg, 1919)**

Examined material. FRANCE • 3 females, 05-Hautes-Alpes, la Bérarde, parc des Ecrins, 44.905°N, 6.316°E, 1910 m, 23 Jul. 2019; 3 males, 1 female, 05-Hautes-Alpes, la Grave, Le Chazelet, plateau des Emparis, 44.905°N, 6.332°E, 1800 m, 23 Jul. 2019; 1 male, 05-Hautes-Alpes, Molines-en-Queyras, vers col d'Agnel, 44.713°N, 6.919°E, 2090 m, 26 Jul. 2020; 2 males, 1 female, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.608°N, 6.731°E, 2345 m, 27 Jul. 2020; 1 female, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.616°N, 6.723°E, 1825 m, 27 Jul. 2020.

- ***Merodon cinereus* (Fabricius, 1794)**

Examined material. FRANCE • 2 females, 05-Hautes-Alpes, la Bérarde, parc des Ecrins, 44.905°N, 6.316°E, 1910 m, 8 Jul. 2005; 1 female, 05-Hautes-Alpes, Molines-en-Queyras, vers col d'Agnel, 44.713°N, 6.919°E, 2090 m, 26 Jul. 2020; 1 male, 05-Hautes-Alpes, Molines-en-Queyras, vers col d'Agnel, 44.700°N, 6.946°E, 2290 m, 26 Jul. 2020; 3 males, 4 females, 05-Hautes-Alpes, Molines-en-Queyras, vers col d'Agnel, 44.692°N, 6.971°E, 2576 m, 26 Jul. 2020; 1 male, 05-Hautes-Alpes, Villar d`Arêne, Col du Lautaret, 45.033°N, 6.403°E, 2050 m, 28 Jul. 2020; 1 male, 2 females, 07-Ardèche, Saint-Martial, Gerbier de Jonc, 44.843°N, 4.195°E, 1430 m, 6 Aug. 2021; 1 male, 1 female, 07-Ardèche Saint-Martial, 44.866°N, 4.195°E, 1400 m, 6 Aug. 2021.

- ***Merodon parietum* Wiedemann *in* Meigen, 1822**

Examined material. FRANCE • 1 male, 2 females, 09-Ariege, Bordes-Uchentein, Maison du Valier, 42.808°N, 1.049°E, 1380 m, 14 Jul. 2020.

- ***Paragus absidatus* Goeldlin, 1971**

Examined material. FRANCE • 2 males, 1 female, 05-Hautes-Alpes, la Grave, Le Chazelet, plateau des Emparis, 44.905°N, 6.332°E, 1800 m, 24 Jul. 2019.

- ***Parasyrphus kirgizorum* (Peck, 1969) / *P. tarsatus* (Zetterstedt, 1836)**

Examined material. FRANCE • 5 males, 10 females, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.611°N, 6.743°E, 2140 m, 20 Jun. 2020; 5 males, 1 female, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.603°N, 6.759°E, 2320 m, 22 Jun. 2020; 1 male, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.613°N, 6.743°E, 2010 m, 24 Jun. 2020.

Notes. In the Alps a long series of *Parasyrphus* was collected (Figs 5, 6), which clearly belong to the same species, but which cannot unambiguously be identified with current literature, displaying features of *P. kirgizorum* and *P. tarsatus*. The specimens are large (11–14 mm), have a clear orange underside of the third antennal segment, and large, black triangular marks on the sternites (Fig. 6). For now, they are left unidentified but for future reference, pictures are provided which may allow for identification once stable characters and species delimitations are reformulated (see Figs 5, 6). Found on flowering *Salix. sp*. at the edges of remnant snow patches. On 22.Vi.2020, a group of hilltopping males (>25) was found at the last larch *Larix* sp. above the treeline at 2320 m. They were sitting on the tree or were hovering close to it.

- ***Pipizella bispina* Šimić 1987**

Examined material. FRANCE • 1 male, 1 female, 05-Hautes-Alpes, la Danchère, path to Lac Lauvitel, 44.982°N, 6.072°E, 1180 m, 25 Jul. 2019.

Found sunning on tree leaves in a small clearing within broad-leaved forest.

- ***Pipizella elegantissima* Lucas, 1976**

Examined material. FRANCE • 1 male, 1 female, 38-Isere, Mont-de-Lans, 770 m, 45.009°N, 6.068°E, 19 Jun. 2019. ITALY •: 2 male, 1 female, Oulx, Amazas Torino, 45.009°N, 6.826°E, 1160 m, 25 Jul. 2020.

Notes. *Pipizella elegantissima* was seen at the edge and along paths of broad-leaved forests on the lower, warmer slopes of the Alps, usually flying low through forest margin vegetation. Though it occurs at rather low elevation, it appears to be mountain species that is so far only known from the French and Italian Alps and the Italian Apennines (Speight, 2020).

- ***Pipizella speighti* Verlinden, 1999**

Examined material. FRANCE • 1 male, 09-Ariege, Bordes-Uchentein, Maison du Valier, 42.802°N, 1.056°E, 1760 m, 14 Jul. 2020.

- ***Platycheirus brunnifrons* Nielsen, 2004**

Examined material. FRANCE • 5 females, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.611°N, 6.743°E, 2140 m, 20 Jun. 2020; 1 female, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.614°N, 6.746°E, 1950 m, 20 Jun. 2020; 3 females, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.605°N, 6.766°E, 2280 m, 22 Jun. 2020; 7 females, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.613°N, 6.743°E, 2010 m, 24 Jun. 2020; 1 female, 05-Hautes-Alpes, Cervières, Col d`Izoard, 44.820°N, 6.737°E, 2400 m, 25 Jun. 2020; 1 female, 05-Hautes-Alpes, Molines-en-Queyras, Fontgillarde, 44.718°N, 6.908°E, 2040 m, 26 Jul. 2020.

Notes. *Platycheirus brunnifrons* were always caught on late flowering *Salix* sp. at the edge of remaining snow patches except for the individual in July that was feeding on a yellow crucifer. The identification of the female *P. brunnifrons* was based on Nielsen (2014) and corroborated by comparison with a long series of male and female *P. brunnifrons* from the Caucasus.

- ***Platycheirus clausseni* Nielsen, 2004**

Examined material. FRANCE • 1 male, 65-Hautes-Pyrénées, Bagnères-de-Bigorre, Tourmalet, 42.901°N, 0.158°E, 2010 m, 17 Jul. 2020.

Notes. Feeding on a low yellow crucifer on a dry scree slope.

- ***Platycheirus complicatus* (Becker, 1889)**

Examined material. FRANCE • 1 male, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.605°N, 6.766°E, 2280 m, 22 Jun. 2020.

Figure 5. Male *Parasyrphus kirgizorum* or *P. tarsatus*, 20.Vi.2020, Vars, Val d'Escreins. Habitus dorsal view with detail of the head (photos by Sander Bot).

Figure 6. Male *Parasyrphus kirgizorum* or *P. tarsatus*, 20.Vi.2020, Vars, Val d'Escreins. Ventral view of abdomen. Note the dark triangular markings on the sternites (photo by Sander Bot).

- ***Platycheirus discimanus* (Loew 1871)**

Examined material. FRANCE • 1 male, 2 females, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.611°N, 6.743°E, 2140 m, 20 Jun. 2020; 2 males, 1 female, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.605°N, 6.766°E, 2280 m, 22 Jun. 2020; 1 female, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.603°N, 6.759°E, 2320 m, 22 Jun. 2020; 2 males, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.613°N, 6.743°E, 2010 m, 24 Jun. 2020.

- ***Platycheirus fasciculatus* Loew, 1856**

Examined material. FRANCE • 3 males, 1 female, 65-Hautes-Pyrénées, Bagnères-de-Bigorre, Tourmalet, 42.808°N, 0.159°E, 2090 m, 17 Jul. 2020; 1 female, 05-Hautes-Alpes, Molines-en-Queyras, top Pain de Sucre, 44.691°N, 6.999°E, 3140 m, 28 Jul. 2020.

Notes. Both in the Alps and the Pyrenees found on scree slopes with sparse vegetation. A male is shown in Fig. 7.

- ***Platycheirus sticticus* (Meigen, 1822)**

Examined material. FRANCE • 1 female, 31-Haute-Garonne, Portet-d'Aspet, 42.941°N, 0.858°E, 1025 m, 11 Jul. 2020.

- ***Platycheirus tatricus* Dušek & Láska, 1982**

Examined material. FRANCE • 1 female, 05-Hautes-Alpes, La Bérarde, parc des Ecrins, 44.905°N, 6.316°E, 1910 m, 7 Jul. 2005; 1 female, 05-Hautes-Alpes, La Bérarde, parc des Ecrins, 44.905°N, 6.316°E, 1910 m, 23 Jul. 2019; 1 male, 2 females, 05-Hautes-Alpes, Villar d`Arêne, Col du Lautaret, 45.026°N, 6.406°E, 2220 m, 21 Jun. 2020; 9 males, 1 female, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.603°N, 6.759°E, 2320 m, 22 Jun. 2020; 1 male, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.605°N, 6.766°E, 2280 m, 22 Jun. 2020; 1 female, 05-Hautes-Alpes, Freissinières, 44.712°N, 6.447°E, 2050 m, 23 Jun. 2020; 1 female, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.613°N, 6.743°E, 2010 m, 24 Jun. 2020; 1 female, 09-Ariege, Bordes-Uchentein, Maison du Valier, 42.802°N, 1.056°E, 1760 m, 14 Jul. 2020; 2 females, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.608°N, 6.731°E, 2345 m, 27 Jul. 2020.

Notes. On 22.Vi.2020, a group of hilltopping males (>25) was found at the last larch *Larix* sp. above the treeline at 2320 m.

- ***Rohdendorfia alpina* Sack 1938 NEW TO FRANCE**

Examined material. FRANCE • 17 males, 11 females, 05-Hautes-Alpes, Molines-en-Queyras, near Pain de Sucre, 44.698°N, 6.991°E, 2780 m, 26 Jul. 2020; 7 females, 05-Hautes-Alpes, Vars, near La Mortrice, 44.574°N, 6.760°E, 2844 m, 27 Jul. 2020; 3 males, 1 female, 05-Hautes-Alpes, Vars, top La Mortrice, 44.574°N, 6.769°E, 3142 m, 27 Jul. 2020.

Notes. A species of bare scree slopes at high altitude. Though this species was never seen before in France, it is very common locally. The numbers listed above are only a fraction of the numbers seen in the field. *Rohdendorfia alpina* was found at both of the two high mountain tops visited in July 2020 and probably is present at many other mountain tops in the French Alps. At La Mortrice, male *R. alpina* seemed to perform hilltopping behaviour. A male and a female are shown in Figs 8, 9.

- ***Spazigaster ambulans* (Fabricius, 1798)**

Examined material. FRANCE • 1 male, 1 female, 05-Hautes-Alpes, Molines-en-Queyras, vers col d'Agnel, 44.700°N, 6.946°E, 2290 m, 26 Jul. 2020; 1 male, 1 female, 05-Hautes-Alpes, Molines-en-Queyras, vers col d'Agnel, 44.713°N, 6.919°E, 2090 m, 26 Jul. 2020.

- ***Sphaerophoria estebani* Goeldlin, 1991**

Examined material. FRANCE • 3 males, 05-Hautes-Alpes, La Bérarde, parc des Ecrins, 44.904°N, 6.332°E, 2400 m, 23 Jul. 2019.

Notes. All individuals were caught on a patch of disturbed and slightly fertilized patch of ground next to a refuge building with sparse pioneer vegetation of yellow crucifers. In the nearby more pristine habitat other *Sphaerophoria* species were found. It is the experience of the author, that many of the species of the *Sphaerophoria rueppellii*-group are linked to disturbed situations with pioneer vegetation: *S. rueppellii* in open lowland situations (ground works, riparian zone of streams,…) *S. shirchan* in recent forest clearings, and *S. estebani* in high mountain areas (scree slopes, human disturbances,…).

- ***Syrphocheilosia claviventris* (Strobl, 1910)**

Examined material. FRANCE • 2 males, 1 female, 05-Hautes-Alpes, Villar-d'Arêne, Col du Lautaret, 45.029°N, 6.401°E, 2075 m, 21 Jun. 2020; 1 female, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.605°N, 6.766°E, 2280 m, 22 Jun. 2020; 1 female, 05-Hautes-Alpes, Freissinières, 44.704°N, 6.435°E, 2240 m, 23 Jun. 2020; 2 females, 05-Hautes-Alpes, Molines-en-Queyras, vers col d'Agnel, 44.692°N, 6.971°E, 2576 m, 26 Jul. 2020.

- ***Xylota triangularis* Zetterstedt, 1838**

Examined material. FRANCE • 1 male, 05-Hautes-Alpes, Vars, Val d'Escreins, 44.614°N, 6.746°E, 1950 m, 20 Jun. 2020.

Hilltopping at montane and Alpine hilltops

During the above-mentioned visits to the French Alps, 13 species were observed hilltopping. Raw estimates of numbers and altitude at which the behaviour was performed are indicated in Table 2.

Discussion

With a rather limited but focused search effort, several new species for the French fauna were discovered (see also Ricarte et al. 2021). This may seem surprising as the visited mountain areas belong to the best investigated departments and areas in France (Speight et al. 2018; Verlinden 2020). However, within these areas, apparently not the full altitudinal gradient has been investigated. The altitudinal window at very high altitudes near and above 3000 m asl yielded a large number of some very rare and two new species for France. Of *Rohdendorfia alpina*, a species new to France, many tens were seen at several places with a limited search effort. Also *P. altomontis* was present in numbers. In the lower montane and alpine meadows between 1200–2400 m that abound in Syrphidae,

Figure 7. Habitus dorsal view of male *Platycheirus fasciculatus*, 17.Vii.2020, Bagnères-de-Bigorre, Tourmalet (photo by Sander Bot).

Figure 8. Habitus dorsal view of male *Rohdendorfia alpina*, 26.Vii.2020, Molines-en-Queyras, near Pain de Sucre (photo by Martin Speight).

mainly with *Cheilosia* (>40 species on a few days in one area), *Platycheirus*, *Pipizella* and *Sphaerophoria*, no new species were found and all these species have been seen repeatedly at multiple locations in France and elsewhere. Indeed, this is the main altitudinal niche explored by entomologists in mountain areas (see e.g. Verlinden 2020).

The high mountain habitat above 2800 m is probably undersampled for Syrphidae over much of Europe. *Platycheirus altomontis* was only recently described (Nielsen 2004) from specimens caught in the Italian Alps near the summit of Mount Scorluzzo (height: 3094 m) in 1998 and was recently added to the Swiss fauna based on old collection material from 1932 (Fisler and Speight 2020), but those are the only published records of this species so far. This species is now found at a first focused search at both French mountain tops investigated in July 2020. Just as with the sightings reported here for France, the other two locations where *P. altomontis* has been seen (Italy, Switzerland) are close to or above 3000 m. Though syrphids may be difficult to locate in the vast hostile and often inaccessible rocky environment

Figure 9. Habitus dorsal view of female *Rohdendorfia alpina*, 26.Vii.2020, Molines-en-Queyras, near Pain de Sucre (photo by Martin Speight).

Table 2. Overview of the species observed hilltopping in the French Alps in June and July 2020. The estimated number of individuals and the elevation(s) (in m asl) of the hilltop(s) are indicated.

Species	Nr. (males)	Elevation (m asl)	Month
Cheilosia canicularis (Panzer, 1801)	15	2345	July
Cheilosia melanura (Becker, 1894)	25	2320	June
Didea alneti (Fallen, 1817)	2	2320	June
Epistrophe leiophthalma (Schiner & Egger, 1853)	1	3142	July
Eristalis tenax Linnaeus, 1758	3	3142	July
Eupeodes flaviceps (Rondani, 1857)	2	3142	July
Parasyrphus kirgizorum (Peck, 1969) / *tarsatus* (Zetterstedt, 1838)	25	2320	June
Pipizella calabra (Goeldlin, 1974)	25	2320	June
Pipizella nigriana (Séguy, 1961)	30	2320	July
Pipizella pennina (Goeldlin de Tiefenau, 1974)	2	2320	June
Platycheirus altomontis Merlin & Nielsen in Nielsen, 2004	3	3142	July
Platycheirus tatricus Dušek & Láska, 1982	25	2320	June
Rohdendorfia alpina Sack, 1938	25	2780/3142	July

of high mountains, it is clear that males of this species aggregate at hilltops at or above 3000 m, as evidenced by this study and by the more than 100 males seen at mount Scorluzzo in Italy. This knowledge of its behaviour and the fact that now also the female can be recognized, may considerably increase the success rate of finding this species of the high mountain habitat in other areas.

Platycheirus is mainly a northern genus, with nearly ¾ of all 63 European species occurring in Scandinavia, although many species also have isolated populations much further south in mountains (Speight 2020). The *P. ambiguus* group to which *P. altomontis* belongs, however, deviates from the general pattern with 12 of the 13 European species occurring in mountains of Central and Southern Europe and 7 species having a southern alpine distribution (Nielsen 2004; Speight 2020). As a rule, the southern alpine species are all very rarely seen and occur on rather dry, rocky, sparsely vegetated mountains at high elevation (2000–3200 m). Though it is never explicitly mentioned, several of these species were found at mountain tops where series of males were collected, suggesting they were hilltopping (Nielsen 2004, this study). Such insight into the ecology of these rare species could help to get a better view on their distribution.

Even at hilltops above 3000 m, *P. altomontis* was not the only syrphid species hilltopping: at La Mortrice also hilltopping males of *Rohdendorfia alpina*, *Epistrophe leiophthalma* (Schiner & Egger, 1853), *Eupeodes flaviceps* Rondani (1857) and *Eristalis tenax* Linnaeus 1758 were present. Earlier in spring, when high hilltops are too cold and covered with snow, lower hilltops and clear landmarks on the slopes, such as large boulders or the last trees above the tree line are locations where hilltopping takes place. On 22 June 2020 together with *Parasyrphus kirgizorum/tarsatus* and *Platycheirus tatricus* also *Cheilosia melanura*, *Didea alneti*, *Pipizella calabra*, *P. nigriana* and *P. pennina* were present. Some of these species were hardly found elsewhere during the period of investigation. Hilltopping males formed loose swarms (*C. melanura*, *P. tatricus*) next to the landmarks, or sat on the landmarks (other species). Hilltopping is a mate finding strategy that is believed to be especially prevalent (and rewarding) in rare species (Skevington 2008), however, very often also more common species engaged in hilltopping. Males of the very common *Cheilosia melanura* were seen hilltopping, but intriguingly they were all small individuals

compared to the larger males of the same species that were found hovering in forest clearings at lower altitudes. Assuming no cryptic speciation is involved, this suggests hilltopping can simply be part of the portfolio of mate finding strategies found within a species, both common and rare, but in this case also that it may be an alternative mating strategy related to specific phenotypes (Hutchings and Myers 1994). There may also be some phylogenetic dependence in hilltopping behaviour: in some genera this behaviour is very common (e.g. many species of *Parasyrphus* and *Pipizella*) whereas it is never seen in other (e.g. *Sphaerophoria* and *Paragus*). More research however is needed, in the first place to establish in which species this behaviour occurs and next into how it evolved and why it occurs.

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Supplementary material 1

Table S1

Authors: Frank Van de Meutter
Data type: excel file
Explanation note: **Table S1.** 205 species of Syrphidae, that have been observed in mountains in France.
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